REMARKS

Upon careful and complete consideration of the Office Action dated July 30, 2009, Applicants have amended the claims which, when considered in conjunction with the comments herein below, are deemed to place the present application into condition for allowance. Favorable reconsideration of this application, as amended, is respectfully solicited.

Claims 1 and 40 have been amended, and new claims 67-69 included. Claims 3, 5, 7, 15, 21-39, 42, 44, 46, and 58-63 remain cancelled. Accordingly, claims 1, 2, 4, 6, 8-14, 16-20, 40, 41, 43, 45, 47-57 and 64-69 are under consideration upon entry of these amendments. No new matter has been entered.

Independent claims 1 and 40 have been amended to require fulvic acid (i.e., the phrase "humic acid and/or fulvic acid" has been replaced with "fulvic acid").

New claim 67 depends from claim 1 and further specifies mixing in humic acid prior to the step of setting. Support for this feature is found at, for example, page 8, lines 7-14 of the application as filed.

New claim 68 is directed to a settable binder composition for mixing with a particulate material and setting to form a solid aggregate matrix. The binder composition includes a mixture of a urea formaldehyde precondensate, a polar solvent, additional urea, and fulvic acid. Support for the subject matter of claim 68 is found at, for example, page 10, line 1 to page 11, line 1 of the application as filed.

New claim 69 depends from claim 68 and further specifies that the settable binder composition includes a sugar. Support for this feature is found at, for example, page 10, lines 13-15 of the application as filed.

In the Office Action, the Examiner has rejected claims 1, 6, 40, and 45 under 35 U.S.C. §103 (a) as allegedly unpatentable in view of International Publication No. WO 00/40669

to De Bruyn ("de Bruyn") in further view of U.S. Patent No. 5,523,049 to Terpstra et al. In making the rejection, the Examiner considers De Bruyn to teach or suggest all of the features of the indicated claims, except the use of a complex fatty acid derived from the oxidation of vegetable sugars (i.e., a humic substance). The Examiner relies on Terpstra et al. for teaching a humic substance (specifically, humic acid) as a component of a binder material.

However, Terpstra et al. do not teach fulvic acid, as required in the instant amended claims. Furthermore, Terpstra et al. in no way suggest fulvic acid. Applicants first observe that Terpstra et al. in no way teach or suggest a class of substances that would generically encompass fulvic acid, such as the class of complex fatty acids. Applicants also observe that, in the only instance in Terpstra et al. where humic acid is mentioned (i.e., col. 4, lines 26-30 therein), humic acid is listed amongst numerous other chemically-unrelated binders, such as glycerol, titanate, stearic acid, polyethylene glycol, and ethoxylated fatty acids. Therefore, absolutely no motivation is provided in Terpstra et al. for a person skilled in the art to contemplate using fulvic acid.

Moreover, Applicants present supporting evidence to the Examiner, in the form of a Declaration (i.e., "Declaration") executed by Henri A. de Bruyn ("declarant"), showing that fulvic acid is highly dissimilar, physically, chemically, and functionally, from humic acid. Significantly, the distinctive properties of fulvic acid endow the claimed invention with advantages and superior properties not realizable by inclusion of humic acid.

As discussed in Paragraph 4 of the Declaration, fulvic acid is that fraction of humic substance (i.e., humins) that is water-soluble (at nearly all pH conditions) and remains in solution after removal of humic acid by acidification. In particular, fulvic acid is highly water-soluble in acidic, neutral, or alkaline conditions, whereas humic acids are water-insoluble in

acidic or neutral conditions and water-soluble only in alkaline conditions. Further support for these assertions is provided in the reference: Michael E. Essington, Soil and Water Chemistry: An Integrative Approach, Chapter 4.4 "Humic Substances" (pp. 155-181), CRC Press LLC, Boca Raton, FL © 2004 (ISBN: 0-8493-1258-2), as attached in the Declaration as Exhibit B.

As discussed in Paragraph 5 of the Declaration, since the binder is often utilized under acidic conditions, fulvic acids provide the advantage of being completely soluble under these conditions. Several other attendant advantages resulting from this higher solubility of fulvic acids are discussed in Paragraph 6 of the Declaration.

As discussed in Paragraphs 7, 8, 9 of the Declaration, fulvic acid possesses physical and chemical characteristics very distinct from humic acid, and these distinct characteristics of fulvic acid impart superior properties to a resulting material into which the binder composition is incorporated. Some of these superior properties include an improved resistance to contraction, cracking, and water infiltration. These superior properties are not provided by humic acid. Further support for these assertions is given in P. McCarthy, et al., "The Principles of Humic Substances," *Soil Science*, vol. 166, no. 11, pp. 738-751 (2001), as attached in the Declaration as Exhibit C.

Furthermore, as discussed in Paragraph 10 of the Declaration, the significantly higher concentration of carboxyl groups in fulvic acid as compared to humic acid endow fulvic acid with the additional advantage of functioning as a source of hydrogen ions that are continually released into the matrix material during processing. The released hydrogen ions help polymerize the binder, thereby increasing the crosslinking and strength of the matrix material. This characteristic of fulvic acids is so pronounced that polymerization of the binder can be effected solely by the fulvic acid, even if no other acid is added. In contrast, humic acid

possesses a significantly lower concentration of carboxyl groups, and thus, humic acid does not exhibit similar beneficial effects when added into a matrix material.

As discussed in Paragraph 11 of the Declaration, fulvic acid also has a significantly smaller molecular weight compared to humic acid. Further support for these assertions is given in Exhibit B (Ibid.) and R. S. Cameron et al., "Molecular Weight and Shape of Humic Acid from Sedimentation and Diffusion Measurements on Fractionated Extracts," *Journal of Soil Science* vol. 23, no. 4, pp. 394-408, (1972), attached in the Declaration as Exhibit D. As further discussed in Paragraph 11 of the Declaration, the smaller size of fulvic acid molecules allow these molecules to more effectively spread when combined with water into the soil, where the fulvic acid can combine with other humic substances and the binder components, to form larger macromolecules during setting. The formation of larger macromolecules results in an improved crosslinking of polymer chains and substrate. The improved crosslinking results in an increased binder strength and water resistance as compared to matrix materials that use humic substances other than fulvic acid.

As discussed in Paragraph 12 of the Declaration, fulvic acids are also significantly more effective crosslinking substances (i.e., by weight) than other humic substances. Therefore, minute quantities of fulvic acid can be mixed with the other components of the matrix material to achieve strength improvements significantly greater than an equivalent amount of humic substances not containing fulvic acids. Furthermore, by the superior ability of fulvic acids to impart structural integrity and other improved characteristics to a matrix material, use of fulvic acids expands the range of usable soils by including those soils that would otherwise not be usable, even with the addition of humic acids, because of their poor physical characteristics.

As discussed in Paragraph 13 of the Declaration, synthetic forms of fulvic acid can be manufactured by more straightforward and facile methods than the manufacture of humic acids. Accordingly, fulvic acid is not only advantageous by its superior properties, but also more commercially feasible.

As discussed in Paragraph 14 of the Declaration, Applicants provide comparative evidence showing the improvement imparted to a matrix material by incorporation of fulvic acid therein, as compared to matrix materials that do not have fulvic acid incorporated therein. Specifically, the graph in the Declaration shows the correlation between applied kPa stress and deflection. The 1% fulvic acid sample (compared to 3% citric Acid with no fulvic acid) reached 3.5 mm deflection at 500 kPa compared to < 3mm and 300 kPa unconfined compressive strength when the samples failed under the load. Similarly, the 2% fulvic acid sample was able to handle > 4 mm deflection and failed at 480kPa, which is significantly stronger than the sample with no fulvic acid. It is noteworthy that the 3% and 4% fulvic acid samples were also much stronger than the sample with no fulvic acid. Significantly, the 4% fulvic acid sample was 100% stronger than the sample with no fulvic acid at 600kPa.

The superior properties of fulvic acid (i.e., in the form of synthetic fulvic acid) is discussed on page 40, lines 12-16, and page 49, lines 5-18, and Fig. 9 of the application as filed. These results corroborate the concept discussed above that fulvic acid possesses distinct advantages over humic acid.

De Bruyn and Terpstra et al. do not teach or suggest a fulvic acid component. Moreover, as is clearly evident, de Bruyn and Terpstra et al. provide not the slightest suggestion that fulvic acid could in some way be advantageous over humic acid for use in a binder material. In contrast, the instant claims, as amended, require a fulvic acid component. The significant

advantages of fulvic acid over humic acid have been discussed above. Therefore, the combination of de Bruyn and Terpstra et al. does not render the indicated claims obvious. Accordingly, Applicants respectfully request that the rejection of the claims under 35 U.S.C. §103 (a) over De Bruyn and Terpstra et al. be withdrawn.

The Examiner has also rejected claims 10, 11, 49, and 50 under 35 U.S.C. §103 (a) in view of de Bruyn and Terpstra et al., in further view of U.S. Patent No. 4,376,088 to Prather ("Prather"). The Examiner relies on de Bruyn and Terpstra et al., as above, for allegedly teaching base claims 1 and 40. The Examiner relies on Prather solely for teaching a surfactant (e.g., dodecylbenzene) in a binder composition. However, as Prather does not compensate for any of the deficiencies already noted for the combination of de Bruyn and Terpstra et al., the combination of de Bruyn, Terpstra et al., and Prather is similarly deficient. Accordingly, as the foregoing combination of references do not render the indicated claims obvious, Applicants respectfully request that the rejection be withdrawn.

The Examiner has also rejected claims 4, 43, 64, and 65 under 35 U.S.C. §103 (a) in view of de Bruyn and Terpstra et al., in further view of U.S. Patent No. 4,886,854 to Markessini et al. ("Markessini"). The Examiner relies on de Bruyn and Terpstra et al., as above, for allegedly teaching base claims 1 and 40. The Examiner relies on Markessini et al. solely for teaching a sugar in a binder composition. However, as Markessini et al. does not compensate for any of the deficiencies already noted for the combination of de Bruyn and Terpstra et al., the combination of de Bruyn, Terpstra et al., and Markessini et al. is similarly deficient. Accordingly, as the foregoing combination of references do not render the indicated claims obvious, Applicants respectfully request that the rejection be withdrawn.

In view of the foregoing comments and amendments submitted in response to the Office Action, which are deemed to be fully in compliance with and responsive to the Examiner's requirements, the early and favorable reconsideration and allowance of the application is earnestly solicited.

Respectfully submitted,

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